ICAL ROOM
AL LIBRARY
OF MICH.

AUG 25 1924

# SCIENCE

NEW SERIES
VOL. LX, No. 1547

FRIDAY, AUGUST 22, 1924

ANNUAL SUBSCRIPTION, $6.00
SINGLE COPIES, 15 CTS.

## Menzies-Wright Ebullioscopic Apparatus

APPARATUS COMPLETE

According to Dr. Alan W. C. Menzies and S. L. Wright, Jr. See Jour. of the Amer. Chem. Soc., Vol. XLIII, p. 2309, Nov. 1921.

**The Latest Development in Boiling Point Apparatus**

There are three essential parts of this apparatus:

*a*—The double jacketed boiling vessel, the upper part of which is constructed so as to form a condenser.

*b*—The lift pump according to the principle of Cottrell, which pumps the solution over the lower bulb of the thermometer.

*c*—The thermometer. This is a water thermometer made from glass tubing a few mm. in bore. Without its handle, the thermometer has a length of about 12 cm.

**Advantages of the Menzies thermometer as compared with the Beckmann:**

*More sensitive. Less fragile.*

Changes in barometric pressure have no effect.
Errors due to lack of uniformity of bore, hysteresis in change of volume of bulb, effect of pressure on volume of bulb, sticking of mercury in capillary, exposed thread, and difference in radiation to and from bulb, which need to be considered in connection with the ordinary Beckmann, are unimportant or nonexistent for the Menzies type.

**In addition, the following errors are avoided with the Menzies and Wright Apparatus:—**

Error due to superheating is eliminated; also, error due to change in superheating caused by change of bubble size due to change of surface tension on addition of certain solutes. No error is introduced due to change of head of liquid above the thermometer bulb. No error arises from fractionation of the solvent or from slow loss by distillation of somewhat volatile solutes.

There are no corks, ground joints or stoppers. It is little affected by draughts, is less fragile and less expensive than the regular Beckmann Apparatus.

The convenience and accuracy of the Menzies Apparatus has caused it to appeal strongly to research students in university and commercial laboratories.

4566-1—Glass parts complete, including boiling vessel, pump and thermometer ..... $17.50
d—Support ..... 1.65
e—Burner with chimney ..... 2.00

Write for Bulletin 286

## EIMER & AMEND

*ESTABLISHED 1851*

*Headquarters for LABORATORY APPARATUS and CHEMICAL REAGENTS*

Washington, D. C.
Display Room
Ev'n'g Star Bldg.

NEW YORK, N. Y.
Third Avenue, 18th to 19th St.

Pittsburgh Agent
4048 Franklin

## *Recent Blakiston Books*

**UNDERHILL—Toxicology**

By **Frank P. Underhill, Ph.D.,** Professor of Pharmacology and Toxicology, Yale University. 8vo, cloth, $2.25.

**SINGER AND KROHN—Insanity and Law**

By **H. Douglas Singer, M.D., M.R.C.P.,** Professor of Psychiatry, University of Illinois, College of Medicine; and William O. Krohn, M.D., Formerly Head of Department of Psychology, Western Reserve University. Imitation Leather, $6.00.

**RADASCH. A Manual of Histology.**
2nd Edition

By **Henry Erdmann Radasch, M.Sc., M.D.,** Professor of Histology and Embryology, Jefferson Medical College, Philadelphia. 333 Illustrations. Cloth, $5.00.

**BACHMANN AND BLISS. The Essentials of Physiology and Pharmacodynamics of Important Typical Drugs**

By **George Bachmann, M.S., M.D.,** Professor of Physiology, School of Medicine of Emory University; and **A. Richard Bliss, Jr., Phm.D., M.D.,** Director of the Departments of Pharmacology and Physiology, in the Colleges of Medicine and Dentistry and in School of Pharmacy of the University of Tennessee. 178 Illustrations. Cloth, $3.50.

**P. BLAKISTON'S SON & CO., PHILADELPHIA, PA.**



## KOFOID and SWEZY

**A NEW AMOEBA**
**Karyamoeba falcata**
**from the Human Intestinal Tract**

*22 pp.; 2 plates; 2 figures in text; 35 cents*

**Cytology of Endamoeba Gingivalis compared with that of E. dysenteriae with special reference to the determination of the Amoeba in Bone Marrow in Arthritis deformans of Ely's second type.**

*34 pp.; 5 plates; 1 figure in text; 50 cents*

**University of California Press**
Berkeley, California



## NATURAL HISTORY
### Specimens and Models

We have been getting together specimens for over fifty years, so are in an exceptional position to supply material for the following sciences:

Mineralogy, Geology, Paleontology, Conchology, Ornithology, Zoology and Entomology

Some of our recent circulars are

S-220 Mineral and Rock Collections
S-243 Wooden Crystal Models
S-223 Relief Maps
S-242 Interesting Fossils
S-241 Microscope Slides of Parasites
S-235 Special Dissections of Animals
S-223 Biological Material for Dissection
S-229 Life Histories of Insects of Economic Importance
SC-37 Human Anatomical Models
SC-38 Comparative Zoology Models
SC-33 Entomological Supplies
SC-31 Taxidermy catalogue

**Ward's Natural Science Establishment**
84-102 College Ave. Rochester, N. Y.



## Naturalists' Supplies

**We carry in stock for prompt delivery**

I. Collecting Utensils.
II. Breeding Apparatus and Cages for Living Animals.
III. Preparing and Preserving Utensils.
IV. Cabinets and Insect Cases.
V. Magnifiers, Microscopes and Accessories.
VI. Botanists' Supplies.
VII. Explorers' and Collectors' Camp Outfits.
VIII. Miscellaneous Naturalists' Supplies.
IX. Oologists' Supplies.
X. Aquaria.
XI. Books and Publications.
XII. Chemicals.
K-S Museum Cabinets of Glass and Metal

**New Illustrated Biological Catalogue will be sent free of charge upon application.**

**The Kny-Scheerer Corporation**
Dept. of Natural Science, G. Lagai, Ph.D.
56 West 23rd St. New York City

# SCIENCE

VOL. LX AUGUST 22, 1924 No. 1547

CONTENTS

*The British Association for the Advancement of Science:*
*Chemistry and the State:* SIR ROBERT ROBERTSON ..... 165

*Publication of Journals in the Fundamental Medical Sciences:* DR. C. M. JACKSON ..... 171

*Scientific Events:*
*The International Union of Pure and Applied Chemistry* ..... 172

*Scientific Notes and News* ..... 173

*University and Educational Notes* ..... 175

*Discussion and Correspondence:*
*Species of Crepis:* PROFESSOR E. B. BABCOCK. *Germanic Pseudo-Science:* PROFESSOR EDWARD W. BERRY ..... 175

*Scientific Books:*
*Mitchell's Text-Book of General Physiology:* PROFESSOR MERKEL H. JACOBS ..... 176

*Recent Contributions to our Knowledge of the Fossil Fishes of California:* DR. CARL L. HUBBS ..... 177

*Laboratory Apparatus and Methods:*
*Respiratory Exchange of the Frog:* DR. GEO. D. SHAFER. *Labeling Microscope Slides:* R. B. STREETS ..... 179

*Special Articles:*
*A Genetic Linkage between Size and Color Factors in the Tomato:* PROFESSOR E. W. LINDSTROM. *The Electromagnetic Nature of Colloidal, Enzyme and Catalytic Action and its Significance:* DR. NORMAN E. DITMAN ..... 182

*Science News* ..... vii

**SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by**

**THE SCIENCE PRESS**

**Lancaster, Pa. Garrison, N. Y.**

**New York City: Grand Central Terminal.**

**Annual Subscription, $6.00. Single Copies, 15 Cts.**

**SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.**

**Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.**

## CHEMISTRY AND THE STATE[1]

IT should be premised that in this account of the relationship of the state to chemistry in Great Britain an attempt has been made to limit it to a description of the more or less direct assistance given by that science to various departments as they came into being or took form. Only in recent years, and as a result of the war, has there been a direct recognition of a corresponding obligation on the other side.

It is obvious that it is to the universities, and, as was the case to a greater extent in the past, to private workers, that the great advances made by British chemists are due. Departmental requirements have, of course, reaped the advantage of these advances, but examples of important contributions to chemical knowledge emanating from the departments themselves are not lacking. The collected story of their connection with the activities of the state may be worth reciting, if it should show the development of its appeal to chemistry and illustrate the gradual breakdown of the view held by the chief of the tribunal before which Lavoisier came that "the state has no need for chemists."

We will find that their employment in an official capacity was in the first instance in connection with the state's pressing necessities, such as its defence, the regulation of its currency and the collection of its revenue, all of them subjects warranting the maintenance of equipment and staff.

As the need for safeguarding the nation's health, well-being and the quality of its food supply became recognized, legislation followed, frequently based on the work of commissions on which sat distinguished chemists of the day, and it became necessary to set up a state chemical department to assist in carrying this into effect.

For some time the science of chemistry had received a limited and vicarious assistance from state grants to the late science and art department and to the universities, but it was reserved for the war to establish definitely and finally the position that the whole future existence of a state might and probably would depend on the existence of a flourishing and efficient chemical industry. This resulted in the definite steps of assisting the application of science to industry and providing direct encouragement for workers in the purely academic field.

It is proposed, therefore, to sketch the develop-

[1] From the address of the president of section B—Chemistry—of the British Association for the Advancement of Science, Toronto, August 7, 1924.

ment of the main chemical activities of the state and to review the conditions in Great Britain in the hope that it may be of use generally to define the present position, and perhaps of interest to this Dominion in the present stage of its chemical development.

* * * * *

In the middle of 1915, at a time when our shortage of many essential materials brought out the need for the application of more scientific methods to our industries if we were to succeed in competition with other countries after the war, the Department of Scientific and Industrial Research was founded. It set out to assist firms in an industry to cooperate with one another and employ a staff of scientific men to solve their problems and develop their industry, to assist other government departments desirous of having investigations carried out, to organize research into problems of practical utility of wide importance and to foster the prosecution of researches in pure science. With the exception of the last, these aims can be considered as coming under the designation of organized applied research. The department has always strongly insisted that it is this type of work only that it seeks to organize, the assisted worker in pure research being left entirely free to follow his bent.

As regards scientific policy, the minister in charge of the department is advised directly by a council of independent scientific men, and these are represented also on the various boards and committees entrusted with the supervision of such investigations as are directed by the department itself.

### RESEARCH ASSOCIATIONS

From the success attending applications of scientific research in military and industrial problems during the war, the lesson was drawn that our industries in peace time should be infused with fresh and more vigorous life by methods which had proved their worth at our time of need. Foresight in these matters was necessary, since it behooved Great Britain, no longer with the industrial world at its feet, to make the utmost use of its resources by adopting the methods that were most efficient and solidly based on science, in order to produce material that would maintain the tradition of the excellence of British goods. While it was recognized that the most powerful chemical industries maintained efficient research staffs, it was decided to encourage separate industries to organize themselves for the cooperative prosecution of research. To the associations erected under this scheme grants, for a term of years only and usually on a pound-for-pound basis, are made from a fund of a million pounds voted by Parliament in order to demonstrate to the industries the advantage of investigating their own technical problems, for it was recognized that many industries would have to carry out research themselves before they could properly appreciate its application.

In its last published report the department remarks on the continuance of these grants to the associations beyond the originally intended period of five years, as this period has proved insufficiently long for the equipment of laboratories and the effective launching of important investigations, especially during a time of industrial depression.

A very wide field is covered by the research associations. Among those that have been set up in which chemistry is important are associations for the textile industries, for rubber, leather and shale oil, for flour and sugar, for non-ferrous metals, cast-iron, glass, refractories and Portland cement, and for scientific instruments and the photographic industry.

As the results obtained by the associations are primarily for the benefit of their constituent members, the onlooker has a chance of gauging the chemical work carried on only from the communications which, following an enlightened policy, the management of some of them permits to be published; and as many of these are contributions to "pure" chemistry, an example is afforded of the opportunity as well as of the necessity for work of this kind in the case of investigations undertaken primarily for an industrial purpose.

It would be impossible to review the work of the research associations for all these industries, even if the data were available, and so reference will be made only to some of their publications, including those of the group which is concerned with the textile fibers, cotton, flax, wool and silk, as the work published presents many interesting features. Thus there are being studied the products of the hydrolysis of cotton, with an obvious bearing on the constitution of cellulose, the chemical constituents of cotton-waxes, and the action of micro-organisms on cotton fibers and fabrics. Flax, hemp and ramie fibers are being investigated as to their distinguishing characteristics and behavior with reagents that affect their luster and absorption of dyes. Wool has been found to have a selective action, whereby it absorbs the alkali from the soap used in scouring, and methods have been evolved for accurately following the action in practice. Similarly with silk, a systematic study is being made of the action of acids and alkalis on the components of this fiber. In the respective laboratories the chemical and physical properties of each of these fibers are being studied and correlated for the purpose of explaining, for example, their strength and luster, and at a recent meeting of the Faraday Society the methods and results of workers in all these fibers were reviewed in a general discussion.

A close scientific scrutiny is being applied to the tanning of leather and the chemical and physical changes involved, together with a bacteriological study of the process. Equally important for this industry and for that of making photographic plates is the study of gelatin, whose chemical and physical properties are being elucidated, while work of benefit to pure science has been published on the effect of light on the photographic plate.

The study of the chemistry of glass and the physical properties associated with changes in its composition is another example of work that has been reported in the literature for improvement of an industry.

The record, as has been stated, must be incomplete, but the subjects mentioned present the appearance of being valuable in the scientific study of material and process and can scarcely fail to lead to the betterment of the respective industries.

### BOARDS

The boards and committees under the department may be broadly divided into those which undertake the investigation of work of national importance and those which undertake work of specific importance to government departments and correlate the scientific work that these carry out.

A large amount of chemical work is carried out by these boards. The departmental research boards and committees dealing with chemical subjects are concerned with the cause of the deterioration of fabrics by organisms and light, and their fireproofing; with the changes that food undergoes under varying conditions of storage and the constitution of fats; with the chemistry of the treatment of timber; with the survey of our coal resources and the economic usage of coal; with the production of alcohol and liquid fuel from waste vegetable matter; with the chemical aspects of the problems of adhesion, lubrication, restoration of museum exhibits; with building materials, paints and the preservation of stone, and with the properties of several of the minor metals. For subjects of the magnitude and importance of some of these, staff and equipment have in several instances been provided on a considerable scale, and a growing number of monographs and communications to the literature issues from the respective boards.

The Coordinating Board for Chemistry, like the similar boards for other sciences, was founded for the purpose of securing interchange of information among government technical establishments, seeing that outside interests are informed, when this is practicable, and arranging for researches not otherwise provided for. The board carries out these duties in consultation with representatives of the Fighting Services and of other government departments materially affected, and with independent chemists, when departmental schemes of work are reviewed in the light of information that may be in the possession of any of the members of the board. To this board are referred questions of wider importance than are within the purview of any one department, and it keeps under its consideration the development of the natural resources of the country. With further facilities for undertaking investigations, it will be in the position to extend such work and to arrange for subjects not otherwise provided for, as well as for those at present under investigation.

### GENERAL RESEARCH

Apart from the indirect help afforded to the universities by means of government grants, direct assistance is given by the Department of Scientific and Industrial Research to research workers who may be students or independent workers, and to important pieces of pure research. To these grants no conditions are attached; they are given for the extension of knowledge.

One of the objects of these grants is to encourage the supply of highly trained scientific research workers to meet the growing needs of the government, the industries of the country, and indeed of the empire. The lack of such was felt acutely during the war, although now, for chemists with the usual qualification at any rate, the conditions have changed.

Students are given grants on the recommendation of their professor that they are a type likely to be greatly benefited by spending two years at research work after taking their degree. In this case the award is for promise and not for achievement, and the hope is entertained that the necessity for these grants will gradually disappear when university finance is on a sounder basis.

Grants are given to independent workers who have shown their capacity for research, and who are handicapped by lack of facilities which they may not be able to secure from private or other sources. Further, in the case of work of unusual importance, very substantial financial assistance may be given when it appears desirable.

In this way comes recognition of the national importance of the highest type of scientific work, and to this, of course, no conditions are imposed as to the lines on which it should be carried out.

The state's appeal to chemistry has developed through the gradual recognition of the need for the application of that science to matters relating to its preservation, its currency, its financial support, its health, its food supply, its industries and finally to academic science.

In the course of this development, advantage has

been taken, if sometimes tardily, of the general advance in chemical knowledge, and frequent recourse has been had to the advice of well-known chemists of the day, and collectively of the Royal Society; thus for various purposes the following chemists, as officials or consultants, have in the past afforded assistance in the solution of specific problems referred to them, or by taking part in commissions: Boyle, Newton, Davy, Faraday, Daniell, Graham, Hofmann, Redwood, Abel, Roberts-Austen, Percy, Dupré, Playfair, Frankland, Ramsay and Dewar. It has happened in several instances that as a result of these commissions and references to chemists some definite chemical activity of the state has emerged.

It will be convenient in this summary to review the state's chemical activities before, during and after the war.

### BEFORE THE WAR

*Defence:* For its defence, establishments for the production of explosives were early maintained, and when this ultimately took the form of a chemical manufacture the government factory took the lead in devising efficient processes, while from the various state research establishments has issued during the last fifty years an important body of original contributions to the theory of explosives and to the knowledge of their properties.

*Metallurgy:* The metallurgical progress of the country has always been a concern of the state by reason of its application to defence by land and sea, and close touch has been maintained with successive developments in the manufacture and use of cast-iron, wrought iron, steel and non-ferrous alloys. While the main advances in process have been made in the great iron and steel works, material contributions to knowledge in this sphere have been made by chemists in the government service.

*Revenue:* For its revenue, imposts were applied in early times, but with great uncertainty, until the charge was put on a scientific basis. Very accurate tables for the strength of alcohol were worked out under the supervision of the Royal Society at the end of the eighteenth century, to be superseded by revised ones issued only a few years ago, when, in addition, new tables were issued also by the Government Laboratory for determining the gravity of worts before fermentation. The question of rendering alcohol unpotable, but still useful for industrial purposes, has occupied much attention. As some misapprehension still exists as to the availability of alcohol for industrial purposes, a statement has been included in which the main facilities are indicated. It was on account of the necessity for safeguarding the revenue that the Government Laboratory was primarily erected, although it now performs chemical work for all state departments.

*Health:* The three main steps with regard to public health and sanitation in this period were the forcing of these questions into prominence by Playfair, with the consequent commissions and legislation leading to the formation of the Local Government Board and its successor, the Ministry of Health, which has many varied activities in preserving purity of air and water and protecting the workman in dangerous trades; secondly, the determination of standards for a safe water supply by the pioneering work of Frankland; and thirdly, the appointment of public analysts by the local authorities, with the Government Laboratory as referee, for safeguarding the supply of food.

*Agriculture:* Science was being applied to agriculture about the end of the eighteenth century, and at the beginning of the next Davy did pioneering chemical work for the Board of Agriculture. Private endeavor is responsible for the next development, state action being limited to the prevention of fraud in the sale of fertilizers and feeding stuffs. In 1909, however, the annual allocation of a sum of money to the Development Commission for the advancement of agriculture stimulated research in a large number of institutions engaged in the scientific study of problems in which chemistry plays an important part.

*Other Activities:* In addition to the chemical work reviewed in the foregoing sections, there is a variety of subjects connected with state departments to which chemists have contributed, such as the composition of the sea, and the composition and physical chemistry of rocks and building-stone. At the Government Laboratory a large number of investigations have been conducted on matters directly referred from government departments.

### DURING THE WAR

In all the activities described the war requisitioned the work of the chemist, but, naturally, predominantly to meet the demands of active warfare.

*Defence:* The attention that had been bestowed on the subject of propellants enabled expansion to take place with no important alteration in the technique of their manufacture, to which was adapted a new type of cordite, ultimately made on the largest scale, without using an imported solvent. For high explosives we were in much worse case, as these had not been made by the government, and were manufactured in Great Britain only in small quantity. Their study at Woolwich led to a rapid evolution of new processes, substances and methods of use. Thus a method was worked out for the manufacture of trinitrotoluene, and to save this substance a new high explosive, amatol, devised. This explosive, consisting of ammonium nitrate and trinitrotoluene, passed exhaustive trials and was ultimately produced at the rate of 4,000 tons a week. The production of

the ammonium nitrate for the mixture was in itself a stupendous undertaking, and the methods of filling the explosive into shell and other munitions gave rise to much ingenuity. In the Research Department, Woolwich, the number of qualified chemists engaged in the study of explosives in all their aspects ultimately exceeded a hundred, while for manufacture and inspection over a thousand were employed. The ideal set before himself by Lord Moulton in 1914, to produce nothing less than the maximum of explosives of which the country was capable, was realized, and they assumed a quality and character that caused them to be copied by our Allies and in reliability proved themselves superior to those of the enemy.

Starting unprepared, and without the advantage of a well-developed fine-chemical industry, we were able ultimately to make a reply in the field of chemical warfare that was rapidly becoming more and more effective; at the same time, by study and often self-sacrificing experiment, protecting the soldier by the development of very efficient respirators. In this connection and in that of explosives nearly every professor of chemistry in the country and many from beyond the sea were engaged.

*Metallurgy:* The enormous demand for metals for munitions and countless other war requirements led to an unprecedented concentration of the metallurgical industries on the needs of the state, and to an equal concentration of metallurgical science on investigation devoted to improvement in quality of materials for new and special war purposes. The work of the Aircraft Production Department, aided by many metallurgists and engineers, on alloy steels, of the National Physical Laboratory on aluminium alloys and of the Metallurgical Branch of the Research Department, Woolwich, on the heat-treatment of heavy forgings and on the drawing of brass is typical of the successful effort made in every quarter. The knowledge thus gained was disseminated in the form of specifications, instructions and reports, and has had a great and permanent effect on manufacture.

*Health:* A committee of the Royal Society had been studying food values, and were able to afford the food controller, when he took office, valuable data bearing on the rationing of food. They had considered subjects which shortly became of much importance, such as a better recovery of flour in milling wheat. The chemical examination of the food for the army in the war, carried out by the Government Laboratory, employed a large staff of chemists. For the supply of many fine-chemical substitutes used in medicine and surgery, formerly imported from abroad, such provisional arrangements had to be made as the organization of a large number of university laboratories on a semi-manufacturing basis.

*Agriculture:* Effects on agriculture during the war were shortage of the usual feeding stuffs for cattle and of fertilizers. The chemists stationed at Rothamsted gave special attention to the shortage of manures and prepared instructions for the guidance of farmers; and several sources of supply of potash were exploited, including kelp, felspar and the flue-dust of furnaces. As sulphuric acid was required for explosive work, fine grinding of phosphates and basic slag was found to be more efficient than was expected. Shortage also directed the attention of chemists to the use of little known food-stuffs, especially for cattle, and the information gained as to their feeding value was important.

*Other Activities:* In many other activities in connection with the war chemists were directly involved, such as in affording advice on the conservation of materials, on the numerous questions arising from the operations of the War Trade Department, on the restriction of imports and exports, and on matters of contraband.

## AFTER THE WAR

The magnitude of the chemical effort, it can be claimed, was a factor in winning the war which must be reckoned as of importance only second to that of the bravery of our forces in the field. But it has left a lasting mark and given to chemistry a value which, were it not for the rapidity with which the achievements of science are forgotten, ought to keep before the public its connection with almost every phase of activity.

*Defence:* To take our subjects in the same order, we may consider some of the effects of the energy spent on the production of munitions. The intensive study of explosives and of other chemical substances used in the war has led to a more complete knowledge of their chemistry, their physical and explosive properties and has advanced chemical theory. These advantages are not of military importance only, but are reflected in the production of trade explosives. The collected records of the Department of Explosives Supply afford examples of treatment of many problems of interest to the general chemical technologist and not only to the explosives expert.

A further benefit was reaped by chemists in every position, from the professor to the youngest graduate, coming into direct contact with manufacturing methods and thus gaining insight into the applications of their science. While it is true that the opportunity came to few of these to take part in the design of plant and primary choice of process, nevertheless the experience was a novel one, as it led them into the field of technology, and can not fail to have widened their outlook. It became apparent that there was a

shortage of a type of chemist which had been developed in Germany, skilled in the transference of the chemical process from the laboratory to the works scale in the largest enterprises. A chemist of this type is one who, besides having a sound knowledge of chemistry and physics, has had experience in the materials of construction used on the large scale and in the operation of the usual types of plant for carrying out the operations of chemical manufacture, and who is capable of working out flow-sheets illustrating the process, and operating plant with every regard to economy. The need for instruction in such subjects had been borne in on men like the late Lord Moulton, and as a direct result of the war-time experience of our deficiencies in this direction has arisen the movement for erecting chairs of chemical engineering in some of our universities. It is to be expected that from these schools, especially where the instruction is super-imposed upon a full graduate course, will emanate men who will lead the way in the application of academic science to industry.

*Metallurgy:* While the interest of metallurgical science in war material has fortunately fallen to a peace-time level, state participation in the support of scientific research remains far greater than before the war. In metallurgy it is exercised through the Department of Scientific and Industrial Research, with its organizations of the National Physical Laboratory and the Industrial Research Associations, as, for example, those dealing with the non-ferrous metals and with cast iron. The state also continues to maintain efficient research establishments for the Fighting Services, but it is significant that the largest of these is undertaking industrial metallurgical research on a considerable scale, for the benefit of the brass and other industries. State support and encouragement are undoubtedly powerful factors in the rapid progress now taking place in every branch of metallurgical science in this country, and there is scarcely any related industry which can fail to benefit.

*Revenue:* Since the war the principal matters affecting the revenue are the higher duties, which have rendered necessary a further denaturation of alcohol. Improved facilities have been granted for the use of alcohol for scientific purposes and in industry; regulations have been formulated for the use of power alcohol and duties have been established on imported fine chemicals and synthetic dyestuffs.

*Health:* The food shortage during the war called attention to the nature and quantity of our food supplies and led to further investigations being undertaken by the Department of Scientific and Industrial Research on food preservation and storage. Activity is also shown by the appointment of committees which are working on the subject of preservatives and coloring matter in food and on the pollution of rivers by sewage and trade effluents. A great field is open in the cooperation of chemistry with medicine in the discovery of substances suitable for the treatment of the numerous diseases now traced to parasites in the blood.

*Agriculture:* So far as fertilizers are concerned, the lack of a supply of fixed nitrogen from the air which obtained throughout the war has now been rectified, and Great Britain for the first time is no longer exceptional among the nations by neglecting to provide itself with synthetic ammonia for agriculture and for munitions. Such war-time expedients as the use of niter-cake instead of sulphuric acid for making ammonium sulphate and superphosphate and the recovery of potash from flue-dust have not survived, but there has been a gain in the further development of "synthetic farmyard manure" and the increased use of basic slag. The present activity in research in agricultural chemistry of a fundamental character is leading to a better understanding of problems of the soil and of plant and animal nutrition and can not fail to be of ultimate benefit to farming.

*Organized Applied Research and Assisted General Research:* Established during the war as a result of an appreciation of the contrast between the successful application of scientific method to military purposes and the want of such application to many of our manufactures, the Department of Scientific and Industrial Research has extended over a wide field. Its main activities have been sketched in the directions of state encouragement to industry to apply chemistry to its problems, of state investigation of vital problems beyond the sphere of private enterprise, and of assistance to workers in the purely academic field. In all these spheres activity is shown by the contributions to knowledge already forthcoming.

In the expansion that has occurred in the chemical sections of state departments since the war, it is interesting to note the increase in the number of chemists that are employed. As far as can be gathered, the number of chemists working in departments maintained wholly by the state is 375 for the present year, compared with 150 in 1912, while in establishments to which the state affords partial support, such as those under the Development Commission and the Research Associations, the corresponding numbers are 150 and 50. In addition, grants are made to 145 research students and to 11 independent research workers, involving a yearly sum of about £50,000.

From the foregoing account of the connection of

the departments of state in the United Kingdom with chemistry, it is possible to trace a gradual development and ultimately a change in attitude, in passing through the stages of compulsion, expediency and assistance.

From motives of security the state was compelled to give heed to chemical matters involved in its defence, such as those which appertained to munitions of war, including metals used in their manufacture; it was constrained to uphold the standard of its currency; and it was obliged to secure a revenue. As a consequence, the first chemical departments were set up in connection with these activities and from them have emanated notable additions to chemical knowledge, improvements in methods of manufacture and specifications for government requirements that have led to improved material becoming available for civilian use. Although mostly conducted with inadequate staff, the study of these questions, it can be claimed, proved of national advantage when the time of need arose.

In the next stage, the public conscience having been awakened by the pioneering work of Playfair, it appeared expedient to safeguard health by attention to sanitation, and, as the quality of food was unsatisfactory, to set up a chemical control. Although a start was made by Davy, a member of the then Board of Agriculture, progress in this subject passed to private enterprise, and a century elapsed before direct assistance was afforded to this important matter. Out of these activities come our present system of supervision over the purity of air, water and food, and also the recent progress made in the application of chemistry and physics to problems of the soil.

The last and more recent stage is in the nature of a recognition that the state is under an obligation to assist science, and in this case the science of chemistry, on which so many important industries are based. It took the war to bring home the danger that, although the record of the country as regards discovery in pure science was unrivalled, its systematic application was too often left to other countries, with the result of lamentable shortages during war and the risk of many industries being ineffective in peace. A measure of government intervention and action appeared requisite, and research became the business of a government department. Outside of the great firms which maintain progressive chemical staffs, the firms in numerous industries have been encouraged and assisted to cooperate in the betterment of their manufactures by the application of the methods of science, and from these associations and the organizations dealing with national problems begins to flow a stream of communications indicative of useful work accomplished. Nor is the foundation of it all neglected, for encouragement is given to workers in the academic field to follow out their ideas, whithersoever they may lead them, in accordance with the truth that "research in applied science might lead to reforms, but research in pure science leads to revolutions."

It is important to be able to record an advance in securing an interchange of information among government departments, and between their work and that of universities, a matter which before the war was unsatisfactory, as it was mainly personal and sporadic.

And it is a hopeful sign also that, although the knowledge and appreciation of the methods and capabilities of science are still generally wanting, there have been of late signs that these matters are coming to engage the attention of those who guide the policy of the state.

ROBERT ROBERTSON

## PUBLICATION OF JOURNALS IN THE FUNDAMENTAL MEDICAL SCIENCES

THERE appears to be a general belief that adequate publication facilities for investigators in medical science are lacking, on account of financial difficulties in the publication of the journals representing the fundamental medical sciences. The Division of Medical Sciences of the National Research Council therefore appointed a committee (C. W. Greene, D. R. Hooker and C. M. Jackson, chairman) to gather information on this subject. Questionnaires were sent to the editors of 23 American journals in this general field, and more or less complete replies were received from the following 19:

*American Journal of Anatomy.*
*American Journal of Hygiene.*
*American Journal of Physical Anthropology.*
*American Journal of Physiology.*
*Anatomical Record.*
*Endocrinology.*
*Genetics.*
*Journal of Bacteriology.*
*Journal of Biological Chemistry.*
*Journal of Comparative Neurology.*
*Journal of Experimental Medicine.*
*Journal of Experimental Zoology.*
*Journal of Immunology.*
*Journal of Infectious Diseases.*
*Journal of Medical Research.*
*Journal of Metabolic Research.*
*Journal of Parasitology.*
*Journal of Social Hygiene.*
*Physiological Reviews.*

The questions asked, together with a brief summary of the replies, are as follows:

The first three questions included the name of editor, name of the journal and the scientific field covered.

(4) *How is journal managed?* The replies include management by an editor or editorial board, in a variety of ways. Business management and editorial management are often separated. Ownership may be private or vested in a scientific institution or a scientific association.

(5) *Of what society or institution may it be considered an official organ?* It is the official organ of a society or institution in 13; not in 6.

(6) *Subscription price per year or volume?* The average is $5.13 per volume (range $2.50 to $7.50). In general, the lower rates are for highly subsidized journals or those with large circulation.

(7) *How many paid subscribers?* The average is 964 (range 250–3,000). Only one is above 1,800.

(8) *What special rate (if any) is allowed to society members or others?* Special rates (discount of 10 per cent. to 50 per cent.; in 1 case, of 100 per cent. to members) are allowed in 9; none in 10.

(9) *If subsidized, how and to what extent?* Subsidies are reported for 11, range from $250 to $7,500 annually (exact data not given in most cases). No subsidy to 7.

(10) *What restrictions are placed on authors as to space, illustrations, etc.?* Variable restrictions are reported in 12; none in 7.

(11) *How many manuscripts were rejected in 1923? Give chief reasons.* In 17 replies the number of papers rejected ranged from 2 to 36. In one additional journal, the number was "more than accepted." "Inferior quality" is the chief reason for rejection. "Too long" or "inappropriate in scope" are other reasons given. No reply indicates that appropriate articles are rejected for lack of space.

(12) *How many free reprints are given?* The number is 100 in 5 cases; 50 in 8; 25 in 2; and none in 4 cases.

(13) *Do you personally believe reprints desirable?* Yes in 15 cases; no in 3.

(14) *Do reprints benefit or injure your journal subscription list? Why?* Six believe they help, largely by advertising; 3 think they injure; 10 can see no appreciable effect.

(15) *Do authors receive an honorarium other than reprints?* All say no; one adding "not as a rule."

(16) *Where is the journal printed?* Several are printed by the Williams and Wilkins Co. (Baltimore) and the Wistar Institute (Philadelphia); the others scattering.

(17) *What is the average printing and distribution cost per page?* Ten replies were received. For these, the average cost per page for each issue is $5.94 (range $1.00 to $9.35). Dividing this by the number of copies printed gives the actual cost per page, which averages somewhat less than $0.009 (9 mills) per page. For the journal with the largest circulation (3,000), the cost is only $0.002 per page.

(18) *What is your office overhead expense per year?* (19) *What other expenses do you carry?* The combined cost of these items, as reported by 12, averages $1,445 (range $100–$4,500). Many small journals get free service.

(20) *What annual subsidy would be required to put the journal on the best efficiency basis?* Average of 17 estimates is $3,171 (range $0–$15,000). Only a few appear adequately provided for.

(21) *Do you believe an Association of Medical Scientific Journals would be advantageous? If so how?* Six say yes; 3 no; 6 doubtful. The affirmatives think costs might be reduced.

(22) *Would joint printing contracts be feasible?* Six say yes; 4 no; 7 doubtful.

(23) *Could standardization of page size, type, etc., be accomplished without detriment?* Eight say yes; 4 no; 6 doubtful.

(24) *Would it be desirable and feasible to have a Scientific Press, jointly financed or owned by the societies concerned?* Six say yes; 6 no; 6 doubtful.

(25) *Could the number of our scientific journals be reduced by broadening the scope of those remaining, without detriment to science and to financial advantage?* Five say yes; 10 no; 3 doubtful. The negatives urge that the tendency to specialization promotes the advancement of science.

(26) *Additional suggestions or comment.* Some of the more striking comments are: "Better support of high class periodicals is the most pressing current need of the biological sciences." "A serious effort should be made to publish only material of unquestioned scientific value." "Subject-matter might be better distributed among the various journals." "The standardization of human creative effort is undesirable."

The committee makes no recommendations upon the questions under consideration, but believes that the data above presented may be of general interest.

C. M. Jackson

National Research Council

## SCIENTIFIC EVENTS

### THE INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY[1]

The fifth meeting of the International Union of Pure and Applied Chemistry was held in Copenhagen on June 26, under the presidency of Sir William Pope. Sixteen countries were represented by about one hundred delegates. The American delega-

[1] From *Industrial and Engineering Chemistry.*

tion consisted of W. D. Bancroft, *chairman,* W. A. Noyes, Atherton Seidell, W. T. Taggart and J. E. Zanetti.

The delegates and ladies were officially welcomed by the mayor of Copenhagen in the great hall of the Raadhuset, and immediately afterwards a reception was held.

The council of the union met the following morning at nine o'clock, and a meeting of the assembly followed at eleven o'clock. The delegates were assigned to the various committees of the union and these began business that same afternoon. At four-thirty the committees adjourned to the National Institute for Theoretical Physics, where Professor Niels Bohr lectured on "Problems of the atomic theory." After the lecture, the delegates were shown the laboratories and particularly the exhibit of hafnium compounds and hafnium-bearing minerals. In the evening the delegates and their families had dinner at the Yacht Club of Copenhagen and were taken for a delightful steamer excursion on the Sund in the soft northern twilight which in Copenhagen lasts until nearly eleven o'clock.

Saturday was taken up by meetings of committees until three o'clock, when the delegates adjourned to the university to listen to Professor Einar Biilman lecture on "The hydroquinone electrode and its applications," and Professor I. N. Brönsted, on "Some remarks concerning the definition of acid and base." The delegates and their ladies were then taken in automobiles to the Glyptothek, one of Copenhagen's finest museums, where a reception was held by the director, Fr. Poulsen.

On Sunday there was an automobile excursion to the famous castle of Elsinore, lunch at "Marienlyst," a summer resort near Copenhagen, and a visit to the castle of Friedriksborg, formerly a royal residence but now a National Museum.

Monday morning was given to committee meetings. In the afternoon the delegates visited the Carlsberg breweries and listened to Professor S. P. L. Sörensen, who lectured on "The solubility of proteins." Director Vagn Jacobsen gave a talk on the brewery and in the evening entertained the delegates at dinner.

Committee meetings were held on Tuesday morning, and in the afternoon the council met to receive the reports of the committees. A meeting of the assembly followed, at which the decisions of the council were duly ratified and a vote of thanks was passed to the Danish Chemical Society for the excellent arrangements and splendid entertainment of the delegates. The fifth meeting closed with a banquet given by the Danish Chemical Society at "Den Kongelige Skydebane."

The next meeting will be held at Bucharest in June, 1925, at the invitation of the Chemical Society of Roumania.

Of the decisions taken by the council, those relating to the finances of the union are of general interest. The council voted that the funds of the union are to be kept on a gold basis in a bank accepting such deposits, in order to avoid embarrassment to the union resulting from fluctuations of exchange rates. It voted also that, beginning with 1925, the quotas of the various member countries shall be paid on a gold franc basis.

The admission of the Union of South Africa, Chile and Esthonia was unanimously voted. A resolution to recommend to the International Research Council that its statutes be so amended as to permit any country which has become a member of the League of Nations to become also a member of the International Research Council and of its unions was brought up at the last meeting of the council of the union, but as many of the delegates had not had the opportunity to discuss it with the governments and organizations they represented, no vote could be taken. It was agreed that this resolution be placed on the agenda for 1925 and that the International Research Council be informed that such a resolution would be voted on by the union at its meeting in Bucharest, in order that no time be wasted in transmission from the union to the International Research Council.

It is worthy of note that, although Sweden is not a member of the union, the Danish Chemical Society unofficially invited the Swedish chemists to attend the meeting and several representatives were present. Sir William Pope, in the name of the council, invited these representatives to attend and take part in all committee meetings.

The arrangements made by the Danes worked with perfect smoothness. While the delegates were working the ladies were taken on sightseeing tours, lunches and teas, which gave them a much-appreciated insight into Danish social life. Every one left the meeting with expressions of admiration, not only for the efficiency with which the plans were carried out, but for their hosts' charming hospitality.

## SCIENTIFIC NOTES AND NEWS

PROFESSOR HORACE LAMB, lately professor of mathematics at the University of Manchester, has been elected president of the British Association for the Advancement of Science for the meeting to be held next year in Southampton, England.

DR. J. C. FIELDS, professor of mathematics at the University of Toronto and president of the Royal Canadian Institute, has been elected president of the International Mathematical Congress.

THE American Astronomical Society, meeting at Dartmouth College, has elected Dr. A. S. Eddington, professor of astronomy at the University of Cambridge, an honorary member.

IN recognition of his attainments in chemistry, the American Institute of Chemists has elected to honorary fellowship Professor Charles E. Munroe, chairman of the committee on explosives investigations of the National Research Council and professor emeritus of chemistry at the George Washington University. This is the second time that this honor has been given to an American chemist, the first recipient being Professor C. F. Chandler, of Columbia University.

DR. MAXIMILIAN TOCH, who has been giving a series of lectures at the National Institute of Technology, Peking, has had conferred upon him the title of honorary professor of industrial chemistry.

PROFESSOR GIOVANNI-BATTISTA DETONI, of the University of Modena, has been elected a corresponding member of the botanical section of the French Academy of Sciences, to take the place of the late professor J. E. B. Warming, of the University of Copenhagen.

THE town of Bethlehem, Pa., has acquired Sand Island, a tract of ten acres of waste land along the Monocacy meadows, which is to be improved and made into a public park and playground. It is to be named Franklin Park, in honor of Dr. William S. Franklin, for eighteen years professor of physics at Lehigh University and, since 1917, professor of physics at the Massachusetts Institute of Technology.

DR. CAMILLO GOLGI, emeritus professor of histology at the University of Pavia, has celebrated his seventieth birthday.

DR. ADOLPH LORENZ, professor of orthopedic surgery at the University of Vienna, on the occasion of his seventieth birthday was elected an honorary member of the Society of Swedish Physicians and of the Norwegian Orthopedic Society.

DR. H. J. H. FENTON, of the department of chemistry of the University of Cambridge, has retired after fifty years of service.

DR. ELLWOOD HENDRICK, of Arthur D. Little, Inc., will become head of the Chandler Chemical Museum of Columbia University on October 1.

DR. BURTON T. SIMPSON, pathologist at the State Institute for the Study of Malignant Diseases at Buffalo, has been appointed director in succession to the late Dr. Harvey Gaylord.

F. L. MICKLE, bacteriologist at the New York Agricultural Experiment Station, has been appointed director of the Bureau of Laboratories of the Connecticut State Department of Health.

DR. CAROLINE RUMBOLD, of the United States Department of Agriculture, formerly in the office of Sugar Plant Investigations, Washington, D. C., is now in the office of Forest Pathology at Madison, Wisconsin.

DR. THEODORE WERTENTHIN, instructor in organic chemistry at the University of Texas, has accepted a position as research chemist with the Solar Refining Company, Ohio.

G. ST. J. PERROTT, associate physical chemist, Department of the Interior, on the staff of the Bureau of Mines, has been detailed to go to Pachuca, Mexico, where he will spend approximately two months observing methods employed in the use of liquid oxygen explosives in a silver-lead mine of the Compania de Real del Monte y Pachuca.

C. A. HOGENTOGLER, of the U. S. Bureau of Public Roads, has been granted leave of absence in order to conduct for the advisory board on highway research of the National Research Council a fact-finding survey of the economic value of reinforcement in concrete pavements. This survey is to be national in scope, and will be conducted in cooperation with agencies interested in the subject. It is proposed to cover the various soils, traffic and climatic conditions throughout the United States.

PROFESSOR E. L. OVERHOLSER, of the division of pomology of the University of California, has recently returned to Berkeley from the Fourth International Congress of Refrigeration, held in London from June 16 to 28, inclusive, where he jointly represented the University of California and the Pacific States Cold Storage and Warehousemen's Association, with headquarters in San Francisco.

DR. HUGH S. TAYLOR, professor of physical chemistry at Princeton University, has departed on a six months' leave of absence in Europe, during which time he will visit laboratories and industries in England, France, Germany and the Scandinavian countries.

AFTER spending six years as professor of silviculture and forest management at the Pennsylvania State Forest School, George S. Perry has received a year's leave of absence which he will spend in north and central Europe traveling and studying forestry science and methods, especially as regards silviculture.

DR. F. L. STEVENS, professor of plant pathology at the University of Illinois, with Mrs. Stevens, has left for a six months' collecting trip in South America. They will visit Panama, Equador, Peru, Bolivia, Chili, Argentine and Brazil, returning to take up university work in February.

DR. VILHJALMUR STEFANSSON has returned from his exploration of Central Australia, and on August 15 sailed for the United States.

PROFESSOR U. S. GRANT, of the department of geology of Northwestern University, and Professor John T. Stark, with eighteen students, left Ely, Minnesota, on August 13, in birch bark canoes on

what is said to be the first outdoor camping geological course ever offered by any college or university. The course is open only to students who have studied geology for a year and a half and regular credit is given.

PROFESSOR N. V. RASHEVSKY, of Prague, delivered two lectures on certain aspects of the theory of relativity, on August 7 and 8, at the Washington Square Laboratory of New York University.

A MONUMENT erected to the memory of J. Henri Fabre, the well-known French naturalist, at Saint-Leons, his native town, was unveiled on August 3.

REPRESENTATIVES of the American Meteorological Society attending the meeting of the British Association in Toronto, have planned a fund in memory of the late Dr. C. LeRoy Meisinger, which is to provide scholarships for students, who will take training for a special aerological career or for other research work in connection with the science of the air.

DR. JOHN J. STEVENSON, professor emeritus of geology at New York University and formerly president of the Geological Society of America, died on August 10, aged eighty-two years.

DR. GEORGE ARTHUR PIERSON, professor emeritus of anatomy, histology and embryology at the University of Pennsylvania, died on August 7, at the age of sixty-eight years.

PROFESSOR HEINRICH PRECHT, who was closely associated with the German potash industry and contributed many important investigations in this field, has died at the age of seventy-two years.

## UNIVERSITY AND EDUCATIONAL NOTES

BY the will of the late J. C. White, former Lord Mayor of Belfast, Queen's University has received £60,000. Of this amount the sum of £40,000 is to be used in founding a professorship of biochemistry and in equipping the department.

H. H. CUSHMAN has given a fund for the establishment of a graduate fellowship in chemical research at Western Reserve University, carrying $750 each term.

AT Vanderbilt University the following appointments to the medical faculty have been made to take effect in 1925: Dr. Glenn E. Cullen, associate professor of research medicine at the University of Pennsylvania, has been appointed professor of biological chemistry; Dr. Ernest W. Goodpasture, director of the Singer Memorial Laboratory at Pittsburgh, has been appointed professor of pathology; Dr. Robert Sidney Cunningham, associate professor of anatomy at the Johns Hopkins Medical School, has been appointed professor of anatomy; Dr. James M. Neill, assistant at the Rockefeller Institute, has been appointed associate professor of bacteriology. During the present year Drs. Cullen and Goodpasture will study in Europe and Dr. Neill will study in this country with grants awarded them by the General Education Board, New York, while Dr. Cunningham will continue his work at the Johns Hopkins University.

DR. W. J. HUFF, of the Koppers Company, Pittsburgh, has been appointed professor of gas engineering at the Johns Hopkins University, to give a new course in gas engineering which is sponsored by the Southern Gas Association.

AT McGill University psychology has been made a department separate from philosophy. Dr. William D. Tait has been promoted from associate professor to be chairman of the department and director of the psychological laboratory. Dr. James W. Bridges, associate professor of psychology at the University of Toronto, has accepted a call to a similar position at McGill University.

WE have been requested to state that Professor A. F. Kidder has not resigned from the College of Agriculture of the Louisiana State University as has been printed elsewhere.

SIR GILBERT T. WALKER, formerly director-general of Indian observatories, has been appointed professor of meteorology at the Imperial College of Science and Technology at South Kensington, in succession to Sir Napier Shaw, who is retiring.

DR. RICHARD WILLSTATTER has resigned his professorship of chemistry at Munich, on account of anti-semitic demonstrations. He has since accepted the chair of chemistry at Heidelberg.

## DISCUSSION AND CORRESPONDENCE

### SPECIES OF CREPIS

AN unfortunate mistake in identity of a certain species of Crepis has gotten into the literature and seems likely to cause much confusion unless corrected. In his first paper on the chromosomes of Crepis, Rosenberg[1] described certain irregularities in chromosome distribution in a species designated as *Crepis Reuteriana*. In his second paper the author[2] uses the same name in referring to his original data.

[1] Rosenberg, O. "Chromosomenzahlen und Chromosomendimensionen in der Gattung Crepis." *Ark. för Bot.*, Vol. 15, 1918.

[2] "Weitere Untersuchungen über die Chromosomenverhältnisse in Crepis." *Svensk Bot. Tidskr.*, Vol. 14, 1920.

Upon request Professor Rosenberg kindly sent the writer seeds of his *C. "Reuteriana"* in 1921. These achenes were identical with those of *C. capillaris* (L.) Wallr. (= *C. virens*), and a large number of plants grown from this seed were all *C. capillaris*. The diploid chromosome number for *C. capillaris* is 6. Inasmuch as the normal diploid number for the plants designated by Rosenberg as *C. Reuteriana* is also 6 and plants grown from the same lot of seed were *C. capillaris*, there can be no doubt that *C. Reuteriana*, as used by Rosenberg, was a misnomer. The responsibility for this error seems to rest primarily with the Copenhagen Botanic Garden, whence Dr. Rosenberg obtained the material in question under the name, *Crepis Reuteriana*. As the determinations of this botanic garden are usually very accurate, Dr. Rosenberg assumed that the material in question was correctly labeled. This case illustrates how important it is that cytologists be very particular as to the identity of the material on which they publish. This is more apparent now than it was only a few years ago, on account of the bearing of recent cytologic, genetic and taxonomic research on phylogeny and evolution.

The chromosome number of *C. Reuteriana* has not yet been determined.

More recent references to Rosenberg's *C. "Reuteriana,"* for example by Heilborn,[3] and the probability that the true *C. Reuteriana* will figure in later investigations, make it desirable that this error in nomenclature be corrected without delay.

The writer has had the privilege of showing this note to Professor Rosenberg, who approves its publication.

E. B. BABCOCK

BERKELEY, CALIFORNIA

## GERMANIC PSEUDO-SCIENCE

I DESIRE to comment very briefly on a pretentious looking publication received recently entitled, "Pflanzenverbreitung und Entwicklung der Kontinente." The author is Edgar Irmscher and the article, which runs to 235 pages and 33 figures, is published by the Institut für allgemeine Botanik, of Hamburg.

The author concludes that the present distribution and the past history of plants can best be explained by the so-called Wegener hypothesis of peripatetic continents and wandering poles. He displays the same ignorance of geological history as does Wegener, but it is not my purpose to waste space in an analysis of his conclusions, which, however, seem to me to be entirely contrary to the facts.

What is serious in its effect on the progress of science and on true scientific method is that a man can get publication for erroneous statements about which he knows nothing, as, for example (p. 70), that the core of Potosi Mountain in Bolivia is not rhyolite, but conglomerate, slate and tuff; that the Concepcion-Arauco flora of the coal measures of southern Chile is Pleistocene in age (p. 81), when actually it is interbedded and overlain with an extensive lower Miocene marine fauna; that the fossil flora from near Tumbez in northwestern Peru is Pliocene in age (p. 67), when it is interbedded with an extensive lower Miocene marine fauna that can be most conclusively correlated with the Miocene of Central America and the Antilles. Much more of a similar sort might be cited.

The fundamental basis for useful scientific speculation is that it shall explain observed facts, or at least that the speculator shall endeavor to substantiate his conclusions by facts of observation, not that facts of observation shall be misrepresented to fit the demands of a subjective hypothesis.

EDWARD W. BERRY

JOHNS HOPKINS UNIVERSITY

[3] Heilborn, O., "Chromosome numbers and dimensions, species formation and phylogeny in the genus Carex." *Hereditas*, Vol. V, 1924, pp. 183–4.

## SCIENTIFIC BOOKS

*A Text-book of General Physiology for Colleges.* By PHILIP H. MITCHELL. McGraw-Hill Book Co. 748 + xix pages.

TEACHERS of college physiology have for a number of years felt the need of a text-book suitable for elementary students, one which would present the more modern developments of the subject with less detail and from a more general point of view than any of the numerous existing works for medical students. Philip H. Mitchell's "Text-book of General Physiology" has been written to meet this need, and the cordial reception which it has received since its publication several months ago indicates that it is likely to fill successfully its intended place.

The book, in the words of its author, "is designed for use by college students who have studied introductory biology, chemistry and physics, but have not studied the organic and physical chemistry that seem prerequisite to the intelligent use of the advanced text-books of physiology and biochemistry which are now available." It is evident that there are several possible ways of attempting to meet the needs of this class of students. At the one extreme would be a text-book of "General Physiology" in the sense in which most readers of the *Journal of General Physiology* and of the writings of Bayliss understand this term. Such a book might use illustrations from the

physiology of man and the mammals where they were particularly appropriate, but would, for the most part, be concerned rather with general principles applicable to all forms of life than with the physiology of any single group of organisms. At the other extreme would be a text-book of human physiology of the usual sort. The author has chosen to avoid these two extremes and to follow a middle course by including as much as possible of both sides of the subject. This policy, while it has certain obvious advantages, has necessarily resulted in some loss of detail in the treatment of many individual topics.

Approximately the first third of the book is devoted to such subjects as: the food of plants and animals; proteins, fats and carbohydrates; the behavior of electrolytes; H and OH ions; vitamins; enzymes; and the physico-chemical structure of protoplasm. A considerable degree of condensation has been necessary to keep this part of the book within the limits assigned to it by the author. Thus, colloids are treated more or less incidentally under proteins, surface tension and cell permeability under fats, osmotic pressure under electrolytes, the rate of chemical reactions under H and OH ions, etc.

The remainder of the book gives a sufficiently complete account of human physiology to make it a suitable text for college students whose interests are primarily in this field. The chapter headings of this part of the book are: "Excitation and inhibition," "Physiology of contraction," "The functional units of nervous systems," "Reflexes," "The correlating action of the nervous system," "Receptors," "Digestion," "Chemistry of blood and lymph," "The circulation of the blood," "Respiration," "Physiological oxidations and heat regulation," "Excretion," "Protein metabolism," "Amounts of food required by animals," and "Internal secretions." In the treatment of these subjects, while the general point of view has not been entirely abandoned, the chief emphasis has been placed upon and most of the illustrative material drawn from the field of mammalian physiology.

The book is written in a clear and interesting style, and typographical errors are relatively few. It is perhaps inevitable that a work which covers such a wide field should in its first edition contain a number of statements which are either inaccurate or misleading. As examples, may be mentioned the following: "This coefficient for chemical reactions is always equal to or greater than 2 for an interval of 10°C." (p. 275), "another advantage of subdivision is the increase of surface tension thus obtained," etc. (p. 236); "This is further confirmed by the smallness of the part of the blood $CO_2$ which may be removed by the vacuum pump without adding acid to break down the bicarbonates of the blood" (p. 566). The author has also at times shown a certain carelessness in his use of physical terms, as, for example, on p. 140, where he speaks of a force of 22.4 atmospheres, and on p. 326, where the statement occurs that "this work is sufficient to raise a weight about nine times as great as that of its own body"—the distance through which the weight is lifted being unspecified. However, such defects as these can readily be eliminated, and they doubtless will be in the second edition which the work deserves and is likely to have. On the whole, the author is to be congratulated on having produced a book which will be of much assistance to teachers and students of college physiology as well as to general readers interested in this subject.

MERKEL H. JACOBS
UNIVERSITY OF PENNSYLVANIA

## RECENT CONTRIBUTIONS TO OUR KNOWLEDGE OF THE FOSSIL FISHES OF CALIFORNIA

THE present note is written for the purpose of calling attention to certain recent discoveries, by David Starr Jordan and associates, through which the remarkable fish faunas of the Miocene and other beds of California are being disclosed.

Dr. Jordan's earlier contributions[1] in this field (and also his two latest papers[2]) dealt largely with the teeth of sharks. A number of interesting fishes of other groups were, however, described. Among these may be mentioned a crossopterygian scale and a remarkable jaw-bone named *Xenesthes velox,* in which the outer surface seems to be covered with denticles, both assigned to the Triassic; a new type related to the pholidophorids, namely *Etringus,* and another new genus *Rogenio,* from the Soledad formation (probably pre-Miocene); a fossil *Gasterosteus,* and finally a series of Quaternary remains of a sturgeon, from the deposits of Potter Creek Cave, and of salmons and suckers from Oregon lake beds.

[1] Jordan, David Starr. "The fossil fishes of California with supplementary notes on other species of extinct fishes," Univ. Cal. Publ. Geol., 5, 1907, pp. 95–144, pls. 11, 12. "Note on a fossil stickleback fish from Nevada," Smiths. Misc. Publ., 52, 1908, p. 117. Jordan, David Starr, and Carl Hugh Beal. "Supplementary notes on fossil sharks," Univ. Cal. Publ. Geol., 7, 1913, pp. 243–256.

[2] Jordan, David Starr. "Some sharks' teeth from the California Pliocene," *Am. Jour. Sci.,* 3, 1922, pp. 338–342, figs. 1–3. Jordan, David Starr, and Harold Hannibal. "Fossil sharks and rays of the Pacific slope of North America," Bull. Sou. Cal. Acad. Sci., 22, 1923, pp. 27–68, many figures.

In 1919 the fishes of the supposedly pre-Miocene Soledad deposits were treated at greater length.[3] *Etringus, Rogenio* and allied forms were discussed, along with the new genus of primitive scombroids, *Auxides,* and a little fish called *Bulbiceps.* The last was referred to the liparids (later doubtfully transferred to the gobiesocids), but the distorted imprint shows no decisive character.

At the same time Jordan, in co-authorship with J. Z. Gilbert—who already had described a fossil flounder from the same beds[4]—published a first account of the truly remarkable teleost fauna of the California Miocene.[5] Although a few of the genera represented, as *Ganolytes* and *Rogenio,* were referred to older (Soledad) types, the majority of the remains were found to be related to fishes living in present, usually Californian, seas. An atherinid genus, *Zanteclites,* was regarded as related to the Melanotaeniinae of Australian fresh waters; it was discussed at greater length in a subsequent paper.[6] The fact that a number of the forms have a high number of vertebrae suggested the hypothesis that the seas in which these fishes lived were cool.

The Pliocene fishes were discussed in a separate, briefer report.[7] Two new genera were described from imperfect remains: *Ectasis,* very dubiously a gonorhynchid (perhaps an elopid), and *Arnoldites,* apparently a gadid.

The Miocene fishes of the richest horizon yet uncovered in North America, namely, the diatom beds of Lompoc, were again described by Jordan and Gilbert in 1920.[8] In this paper a number of new generic types were diagnosed, and the large series of scombroids found in these beds reviewed. In a supplementary paper,[9] the remains first regarded as a flounder were shown through more complete examples to represent the remarkable oceanic fish, *Lampris.* This discovery was of particular interest in demonstrating the antiquity of this peculiar type.

A popular account of those Miocene fishes followed.[10] In this, the simultaneous destruction of about twelve hundred million individuals of a herring-like species (*Xyne grex*) was recounted.

Subsequently, the Tertiary fish fauna of California was again revised, the paper being illustrated with numerous restorations.[11] "The purpose of this paper is to make old bones live again." The dermal structures, which of course were largely unpreserved, were drawn from the supposedly nearest living relatives.

In this paper Jordan advanced a series of very interesting and important generalizations regarding the fauna.[12] He concluded that:

> The present fauna of California is derived from that of the Miocene period with a slight admixture from the northward and from Japan. The Tertiary fauna of California is nearly all included in families still extant on the coast. All the species are distinct from their living allies, and most of them must be placed in different genera.
>
> The most striking difference which appears thus far is that we have found no trace among the fossils of the viviparous surf-fish (Embiotocidae) which form so conspicuous a part of the existing fauna.
>
> Among the fossil fishes actually known we have none which suggests any affinity with Asiatic forms. Most of them are distinctly characteristic of California, a few only belonging to types now wanting in that region, but represented in the Gulf of Mexico, and in one or two cases in the Mediterranean. In Miocene times, the present Isthmus of Panama was an open channel.
>
> No species, either distinctly tropical or distinctly subarctic, appear among the Tertiary fishes of southern California. We must, therefore, conclude that the Miocene temperature differed little from that which obtains at present.
>
> It is evident from the absence, partial or complete, of silt or other rain-washed material in the deposits containing the fishes, that the climate was arid.

It is a matter of high regret that many of the fish remains of these diatom shales are so poorly pre-

[3] Jordan, David Starr. "Fossil fishes of southern California. I. Fossil fishes of the Soledad Deposits," Stanford Univ. Publ., Univ. Ser., 1919, pp. 3–12.

[4] Gilbert, James Zaccheus. "Evesthes jordani, a primitive flounder from the Miocene of California," Univ. Cal Publ., Geol., 5, 1910, pp. 405–411, pls. 41–42.

[5] Jordan, David Starr, and James Zaccheus Gilbert, "Fossil fishes of southern California. II. Fossil fishes of the Miocene (Monterey) formations," Stanford Univ. Publ., Univ. Ser., 1919, pp. 13–60.

[6] Jordan, David Starr, and Carl Leavitt Hubbs. "Studies in ichthyology. A monographic review of the family of Atherinidae or Silversides," Stanford Univ. Publ., Univ. Ser., 1919, pp. 1–87, pls. 1–12 (*Zanteclites* described on pp. 10–12, and figures on pl. 11).

[7] Jordan, David Starr, and James Zaccheus Gilbert. "Fossil fishes of southern California. III. Fossil fishes of the Pliocene formations," Stanford Univ. Publ., Univ. Ser., 1919, pp. 61–64.

[8] Jordan, David Starr, and James Zaccheus Gilbert. "Fossil fishes of diatom beds of Lompoc, California," Stanford Univ. Publ., Univ. Ser., 1920, pp. 1–45, pls. 1–29.

[9] Jordan, David Starr. "An ancient moonfish," *The Scientific Monthly,* 2, 1920, pp. 470–473, figs. 1–3.

[10] Jordan, David Starr. "A Miocene catastrophe," *Natural History,* 20, 1920, pp. 18 ff. (reprinted in *The Guide to Nature,* 13, 1921, pp. 132 ff.).

[11] Jordan, David Starr. "The fish fauna of the California Tertiary," Stanford Univ. Publ., Biol. Ser., 1, 1921, pp. 233–300, pls. 1–57.

[12] These generalizations were repeated in another paper, "The Miocene shore-fishes of California," *The Scientific Monthly,* Nov., 1921, pp. 459–463, 4 figs.

served. Sometimes little but the imprint of the fossil remains, and even this is usually much distorted, particularly in the head region. This being the case, the identifications must be based on the general proportions and on the relationships of superficial parts to a greater degree than on osteological details. Dr. Jordan's extremely wide knowledge of modern fishes must, therefore, have been almost indispensable in the work he has done. Despite this advantage, however, the relationships of a considerable number of the forms described could not be definitely determined. Occasionally, the estimate of kinship was widely altered in subsequent papers. For example, a fish first regarded as a herring was (from better material) later referred to the Synentognathi, while a supposed labrid was later shown to represent a clupeid. It must be noted, however, that in the later papers a greater attention to the skeletal features which are yet apparent—particularly the interneurals and interhaemals, as related to one another and to the fin rays—has added an increased definiteness to the identification and the determination of relationships.

The reviewer feels constrained to express his opinion that throughout the work (as in so many treatises on fossil fishes) too many imperfect and incomplete impressions were considered. To name and to attempt the classification of fossil remains of clearly indeterminate relationship can hardly serve to advance our knowledge of extinct faunas. In the case under review, a close study of the best preserved remains of these Tertiary fishes (some show exquisite detail) would in his opinion have yielded the same generalizations, and would have added stability to the nomenclature, and prevented the intrusion into the work of certain elements of unnecessary doubt.

CARL L. HUBBS

MUSEUM OF ZOOLOGY,
UNIVERSITY OF MICHIGAN

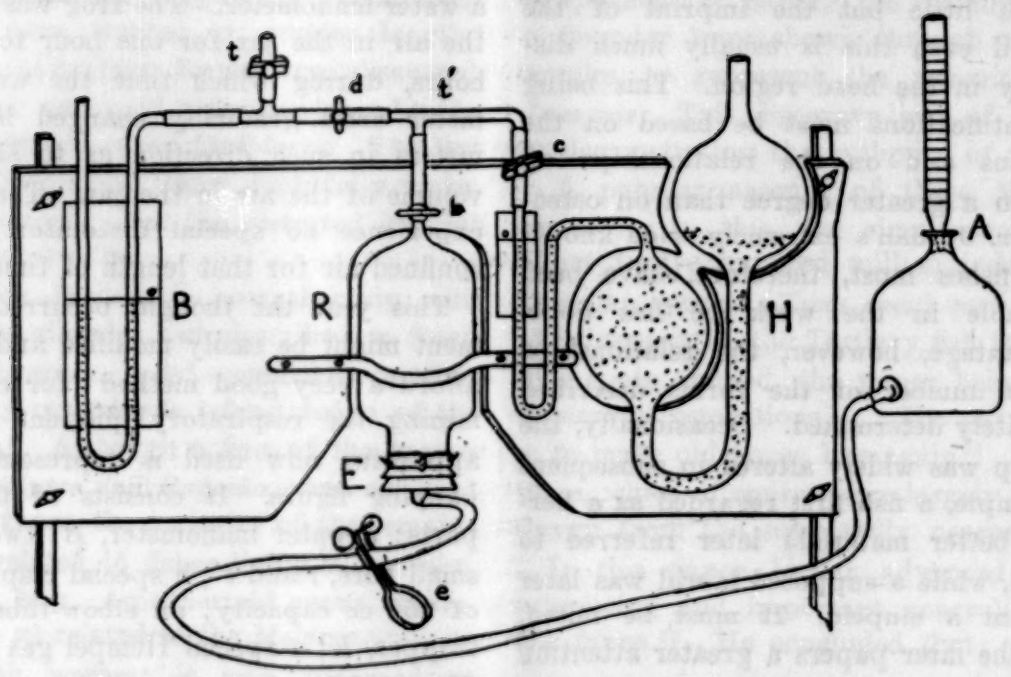
## LABORATORY APPARATUS AND METHODS

### RESPIRATORY EXCHANGE OF THE FROG

THREE years ago the writer began using a very simple class demonstration to show the change in volume imposed upon respired air during the respiratory exchange of the frog in its winter or early spring condition. A short metal tube was soldered over a hole made in the lid of a one-pint Mason fruit jar. A frog was placed in the jar and the jar-lid was screwed down air tight. About three minutes were allowed for the changing volume of air in the jar, occasioned by the slightly warmer body of the frog, to reach equilibrium, and then, by a suitable rubber tube, the metal tube of the jar-lid was connected with a water manometer. The frog was allowed to breathe the air in the jar for one hour to one and one half hours, during which time the water in the manometer arms gradually changed level several centimeters in such direction as to show a decrease in volume of the air in the jar. The frog appeared to experience no special discomfort in breathing the confined air for that length of time.

This year the thought occurred that this experiment might be easily modified and extended so as to afford a very good method (for class use) of determining the respiratory quotient of the frog. The apparatus now used is represented in the accompanying figure. It consists of the following glass parts: a water manometer, *B*; two heavy T-tubes of small bore, *t* and *t'*; a special respiration chamber, *R*, of 250 cc capacity; an elbow-tube through a rubber stopper, *E*; a special Hempel gas absorption pipette, *H*, of 250 cc capacity, and an ordinary aspirating bottle, *A*, of 250 cc capacity having a Mohr burette (25 cc graduated to 1/10 cc) inserted through a rubber stopper in its top in such manner that, as water rises from the aspirating bottle into the burette, air can not be trapped beneath the stopper. These parts are connected by rubber tubing as illustrated. The neck of the respiration chamber at *E* has an opening of 45 mm in diameter and takes a No. 10 rubber stopper. A metal collar around this neck of the chamber bears two hooks over which a pliable wire may be tightly looped to hold the stopper in exact place during the experiment. The chamber may be closed above with a glass stop cock, *b*. At *c*, *d* and *t* are screw pinch cocks, and at *e* is a Mohr's pinch cock. A solution of one part of KOH to two parts of water is used in the Hempel pipette. The aspirating bottle with its burette and its tubing is filled with pure water. It was found that acidulated water (HCl) may not be used. Even when the acid used is weak enough to seem not especially irritating to the skin of the frog, it nevertheless appears to be absorbed by the skin so that $CO_2$ is liberated from the alkaline carbonates of the blood. Thus the volume of the gas in the respiration chamber slowly but constantly increases until the frog dies.

When an experiment is to be started, the apparatus (as described) and the frog to be used are brought into a room where the temperature is comparatively constant and kept until they are as nearly as possible the same temperature as the air of the room. Then cock, *c*, is closed and cocks *b*, *d* and *t* are opened. The frog is introduced into *R* and the stopper *E*, is fastened securely in place with care not to place the hand on *R* so as to change its temperature. Cock, *e*, is opened to pass just enough water into *R* to cover the stopper, *E*, and seal it. Under these conditions, the manometer will read level




Apparatus used for showing the change in volume of air respired by a frog, and for determining the R. Q.

at atmospheric pressure. Cock, *t*, is now closed. For two or three minutes, thereafter, it will usually be observed that the outer limb of the manometer rises, indicating that the volume of the air with the frog is increasing a little. This appears to be due to the frog's body being very slightly warmer than the air. The volume ceases to increase within about two minutes, as a rule; then *t* is momentarily opened and closed again to restore the manometer to zero at atmospheric pressure, and the experiment begins. Gradually the manometer will show that the volume of the air with the frog is slowly decreasing. The best results are obtained, with a respiration chamber of this size, by terminating the experiment in 20 to 25 minutes, depending somewhat on the activity of the frog. It seems best in other words not to allow the difference reading of the manometer arms to exceed eight or nine centimeters. The reason for this will be pointed out in a moment. When the respiration period is to be terminated, the burette of *A* is read, then cock, *e*, is opened to allow the passage of just enough water into *R* to restore the zero level of the manometer. The burette of *A* is again read. Cock, *d*, is now closed, and *c* is opened. The bottle, *A*, is raised and cock, *e*, is opened. Water flows into *R* until most of the respired air is driven into the KOH pipette. The air is then returned to *R*, by lowering *A*, for a moment. This operation is repeated three times—all the air being sent into *H* the third time—care being used that no water is driven beyond *b* and that no KOH is drawn beyond *c*. When the water goes over the frog's head, he promptly stops lung breathing, and suffers no ill effects, until the air is returned from the Hempel pipette. As the air is returned the last time, the KOH solution is carefully stopped just as it rises to the zero point of the Hempel absorption pipette. Cock, *c*, is then closed and cock, *d*, is opened. The aspirating bottle, *A*, and cock, *e*, are now manipulated, if necessary, until the manometer stands at zero. The burette of *A* is read again. The manipulation for $CO_2$ absorption should occupy four or five minutes. Even then the manometer level will be apt to change at first in such direction as to show a slight increase in the volume of the air with the frog, but this should not make a difference of more than 0.2 cc in the final reading of the burette at *A*. During the course of the experiment, the percentage of $CO_2$ in the air confined in the respiration chamber gradually increases until slightly abnormal amounts of $CO_2$ begin to be retained in the blood of the frog. This $CO_2$ is given off by the frog comparatively rapidly after the $CO_2$-free air from the Hempel pipette is returned to the respiration chamber, hence the necessity of returning the air three times. However, if the respiration period has been continued for an hour or so (too long, for a chamber of this size), the abnormal accumulation of $CO_2$ in the frog will be so great as to require considerable time for it to be given up—thus too greatly prolonging the time used in absorbing $CO_2$.

Let *n* equal the first reading of burette, *A*, with the manometer level at atmospheric pressure.

Let *m* equal the second reading of burette, *A*, at the end of the respiration period, after the manometer is restored to the zero level.

Then the difference $(m - n)$ equals the volume of the oxygen taken up by the frog, less the volume of the carbon dioxide given off in respiration.

Let *p* equal the reading of burette, *A*, after $CO_2$ absorption in the Hempel pipette.

Then $p - m$ equals the volume of $CO_2$ given off in respiration.

$p - m + (m - n)$ equals $p - n$ equals the volume of oxygen retained by the frog during the respiration period.

R. Q. equals $\frac{CO_2}{O_2}$ equals $\frac{p - m}{p - n}$

A series of nine experiments carried out in the manner described on the same frog gave the following values for the respiratory quotient: 0.71; 0.72; 0.76; 0.80; 0.65; 0.69; 0.72; 0.70; 0.78. Of course the method has its obvious limitations as to accuracy and must not be urged, in that respect, in comparison with those methods which permit the animal to breathe fresh air throughout the experiment and also allow the respiration period to be terminated on an exact moment. Nevertheless, the results obtained are fairly uniform and the method does afford some advantages as a laboratory experiment for illustrating the facts involved in the respiratory exchange. The manometer visibly impresses the student with the fact that in case of an animal oxidizing protein and fat the volume of the oxygen used in respiration is greater than the volume of the carbon dioxide given off. The experiment may be carried out in a comparatively short time and the operation is simple—only one absorbent fluid being necessary. A "cold blooded" animal is made use of, so that the temperature of the respired air is so slightly above that of the surrounding air as not to interfere with the immediate volumetric work, as may be the case when a mammal is used.

GEO. D. SHAFER
STANFORD UNIVERSITY

## LABELING MICROSCOPE SLIDES

THE method developed by the writer of preparing labels for microscope slides has been used sufficiently by the departments of plant pathology and botany at the University of Wisconsin to warrant the hope that it will prove of value to others.

In the preparation of a large number of, or even a few, microscope slides for class use satisfactory labeling of the finished slides is often an important problem. Printed labels are expensive, while printing or writing even a few duplicate labels is both time-consuming and irksome, and requires unusual skill for satisfactory results.

The method herein described produces in any quantity neat, accurate labels in the form of photographic prints the exact size of a standard slide label and gummed ready for use. In addition the process is simple, rapid and inexpensive, and requires very little special equipment.

The original copy from which the negative is made may be drawn to any scale, preferably two or three times the desired size. The standard slide label is fifteen sixteenths of an inch square. A piece of white bristol board or drawing paper is ruled with a 3H pencil into squares of three times the linear dimensions of the slide label. As a matter of economy of time and materials 12 or 24 different labels are prepared at one time on a single large sheet of paper. Twelve labels arranged in three rows of four each can be photographed on a 4 x 5 plate, leaving about one half inch margin all around for convenience in handling. Similarly, 24 labels in four rows of six each will go on a 5 x 7 plate.

The data are now lettered in the squares in pencil, using penciled guide lines which may be ruled for the entire sheet at one time. After having been checked for errors, the labels are inked with black waterproof ink, using a ruling pen for straight lines and Barch-Paysant lettering pens (Keuffel and Esser Co.) for the lettering. Pens No. 4 and No. 5 are suitable for lettering a label enlarged three times (Fig. 1, A), while No. 5 and No. 6 are suitable for a label enlarged two times (Fig. 1, C). The necessity of allowing for reduction in the width of lines is emphasized by Fig. 1 in which B and D are photographic reductions of A and C. It also shows that slight imperfections in the lettering are minimized by reduction.

The completed sheet of labels is cleaned with art gum, photographed on a process plate, and developed in a contrast developer (hydroquinone). To avoid distortion of the image on the plate the center of the copy should be approximately on the optical axis of the camera lens, and perpendicular to it. The image is easily tested for size by measuring with a slide labeled on the ground glass, or for squareness, by measuring the diagonals, which should be equal in length. As many prints as are desired can now be quickly made from the negative, which may be preserved for future needs. A dull or semi-gloss printing paper is preferred by the writer to a glossy paper. Solar, a thin, matt-surfaced printing paper made by the Defender Photo Company, gives labels of practically the same thickness and surface as the commercial labels.

The adhesive is applied to the back of the prints before the labels are cut apart. An adhesive prepared from animal glue was found superior to the various commercial liquid glues tested. The following formula is a slight modification of one suggested by Mr. Wilbur Jones, of the Forest Products Laboratory, Madison, Wisconsin. A good grade of animal glue, which comes in small flakes, is dissolved in twice its weight of water in a water bath. When the glue is thoroughly dissolved, ten per cent. of glycerine (by volume) is added to make it flexible when dry, and one half per cent. of betanaphthol as a

Fig. 1. Figures showing scale to which originals (A and C) are drawn to produce finished microscope slide labels (B and D) by photographic reduction. A is drawn three times size of finished label B; C is drawn twice size of D. Either scale can be used with good results.

preservative. This adhesive is a firm jell at room temperatures, but of the consistency of mucilage when heated to 60° C. in a water bath.

The adhesive is applied to the back of the prints in an even layer using a small flat brush. To facilitate a quick, even coating of the prints they should be placed upon a warm surface (an electric slide warmer is very satisfactory). The adhesive dries in about fifteen minutes, and the labels may be cut apart along the penciled guide lines. A trimming board gives very straight even margins. Both printed and gummed surfaces of the labels are fully equal to the commercial product in permanence either before or after they have been moistened and rubbed into good contact with the slides.

Rubert B. Streets
Department of Plant Pathology
University of Wisconsin

## SPECIAL ARTICLES

### A GENETIC LINKAGE BETWEEN SIZE AND COLOR FACTORS IN THE TOMATO[1]

Genetic factors responsible for size characters are notoriously elusive, and their actual presence in the germinal complex is largely hypothetical. They can not be isolated singly and studied as units, a mode of procedure that has led to some tangible results in the case of equally complex factors for qualitative characters. One of the most direct methods of actually proving the existence of definite size (quantitative) factors is that of linking them with the well-known system of chromosomal factors in any species. Such a method should give proof of the genetic similarity of the two types of genes.

In a large series of crosses between commercial varieties of tomatoes, involving various sizes (weights) and colors of the fruit, a definite linkage between these two types of genetic factors has been established. Color in tomato fruits is mainly determined by two different pairs of genes. One pair, *Rr*, controls the red and yellow flesh color, the former being dominant. The other pair, *Yy*, determines skin color, *Y* producing a yellow pigment in the cell walls of the epidermis of the fruit, and *y* giving a colorless condition in these cells which is recessive in inheritance. Size of fruit in tomatoes is perhaps best interpreted by the multiple factor hypothesis.

Crosses involving these two pairs of color genes and different sizes of the fruit were made reciprocally. The $F_2$ generations and reciprocal crosses of the $F_1$ plants with pure varieties of the double recessive color phase (*rr yy*), were grown with extraordinary precautions as to uniformity of treatment, replication, etc. Measurements for each plant were taken of average weight of fruit, time of flowering, two diameters of the fruit, and number of seed locules. In every case, the $P_1$, $F_1$, $F_2$ and backcrosses under consideration were grown during the same season.

One series of crosses and backcrosses has given some very outstanding results. In this case, the parents were the varieties Red Cherry (*RR YY*, mean fruit weight $7.3 \pm 0.3$ grams) and Golden Beauty (rr yy, mean fruit weight $166.5 \pm 6.4$ grams). The $F_1$ of this cross and its reciprocal, grown the same season as the $P_1$ and $F_2$ generations, had a mean fruit weight of $23.9 \pm 0.4$ grams indicating a noticeable dominance of the smaller fruit type. This $F_1$ was crossed back to the pure Golden Beauty parent and also to an unrelated variety, Yellow Peach (*rr yy*).

The $F_2$ data, with respect to color of fruit, showed the di-hybrid distribution of four color classes, *RY*, *Ry*, *rY* and *ry*. The mean weight of fruit in grams for these four kinds of fruits was as follows:

| | *Red Fruits—R* | | *Yellow Fruits—r* | |
|---|---|---|---|---|
| | *Y* | *y* | *Y* | *y* |
| $F_2$ means— | $22.0 \pm 0.7$ | $37.3 \pm 1.8$ | $21.9 \pm 1.4$ | $46.6 \pm 5.6$ |
| Differences— | $15.3 \pm 1.9$ | | $24.7 \pm 5.8$ | |

It is perfectly obvious that the types with colorless skin (*y*) are consistently heavier than those with

[1] Paper No. 4, Department of Genetics, Iowa State College, Ames, Iowa.

the yellow ($Y$) skin, whether the fruits are red or yellow in flesh color. In other words, there is a significant tendency for the $F_2$ fruits to vary towards the parental types as regards both skin color and weight, since the large parent (Golden Beauty) contributed the $y$ factor, and the smaller parent (Red Cherry) the $Y$ factor. The differences noted above are statistically significant, because the one between the two sorts of red fruits is 8 times its probable error, and the other difference is 4.3 times its probable error.

Verification for this relation between skin color and weight factors was afforded by two series of backcrosses of the same $F_1$ plant used to produce the $F_2$. In the backcross to the pure Golden Beauty parent, the same four color types appeared in the progenies, but in approximately equal numbers. The mean weights (in grams) for the four colors of this backcross and its reciprocal are as follows:

| | *Red Fruits—R* | | *Yellow Fruits—r* | |
|---|---|---|---|---|
| | *Y* | *y* | *Y* | *y* |
| Backcross to G. B. parent | 50.4 ± 2.9 | 84.1 ± 4.5 | 52.6 ± 2.3 | 75.3 ± 3.2 |
| Differences— | 33.7 ± 5.3 | | 22.7 ± 3.9 | |

Here, likewise, the tendency for the $y$ type of fruit to be heavier than the $Y$ class is apparent. Among both the red and yellow fruits, the differences in weight between the skin color classes are statistically significant, being approximately 6 times their respective probable errors of the difference.

Another backcross to the same $F_1$ plant gives further evidence. In this case the Yellow Peach variety was used reciprocally on the $F_1$ of Red Cherry × Golden Beauty with the following results:

| | *Red Fruits—R* | | *Yellow Fruits—r* | |
|---|---|---|---|---|
| | *Y* | *y* | *Y* | *y* |
| Backcross to Y. P. Variety | 28.5 ± 0.9 | 45.3 ± 1.6 | 31.1 ± 1.3 | 41.0 ± 1.7 |
| Differences— | 16.8 ± 1.8 | | 9.9 ± 2.1 | |

When it is recalled that the Yellow Peach variety used in this backcross was in no way related to the parents or $F_1$, it becomes evident that the situation is perhaps general and not specific for the particular varieties of the cross.

Accordingly, the evidence from three distinct sources admits of the same conclusion that the color factor pair $Yy$ is closely linked with genetic factors for weight of fruit. On the modern theory of inheritance the same chromosome that carries $y$ in the Golden Beauty variety also bears a major factor for a greater weight of fruit.

It is interesting to note that red and yellow flesh color, dependent on genes $R$ and $r$, seem to be independent of weight. This is true not only for the varieties noted above, but also for a large series of crosses involving the well-known varieties, Bonny Best and Yellow Cherry. The details of these crosses are reserved for a future report when larger progenies will be available so that small differences might be detected and checked biometrically.

It might be added that the number of seed locules also exhibits a linkage with the $Yy$ color factors but to a somewhat lessened degree. This is to be expected, however, since weight and number of locules in the $F_2$ generation show a high correlation ($r = .6056 \pm .0427$). The same general relation exists between $Yy$ and time of flowering, although in this case the correlation between weight and time of flowering is not very high, $r$ having a value of $.2799 \pm .0622$. These evidences of a linkage between the color genes $Yy$, and both time of flowering and number of seed locules merely afford other sources of verification for the situation proved with respect to weight of fruit.

A final proof for the general situation rests with a cross between a small variety with colorless skin and a larger variety with yellow skin, the reverse of the Golden Beauty × Red Cherry cross. If the *small* size of fruit is then found to be linked with the $y$ color factor, the case is complete. Such a cross has been made, involving the Yellow Peach and Bonny Best varieties, but at least two generations of plants are still required to obtain the adequate data. Meanwhile, it is hoped that other investigators may test this linkage with different varieties of tomatoes under other conditions. It opens a fertile field of research for testing the fundamental relation between genetic linkages involving quantitative characters and those correlations so conveniently studied by multiple correlation methods with their path coefficients and coefficients of determination.

E. W. LINDSTROM

IOWA STATE COLLEGE

## THE ELECTROMAGNETIC NATURE OF COLLOIDAL, ENZYME AND CATALYTIC ACTION AND ITS SIGNIFICANCE

IT is well known that when a colloidal solution of platinum is mixed with a solution of peroxide of hydrogen, there occurs an evolution of oxygen gas, set free from the peroxide of hydrogen molecule.

If, instead of mixing these two solutions, the peroxide of hydrogen solution is put in a fermentation tube, and in a test tube is put a solution of colloidal platinum, and the two solutions are then connected by an electrical conductor, such as a copper, iron or preferably a platinum wire, there